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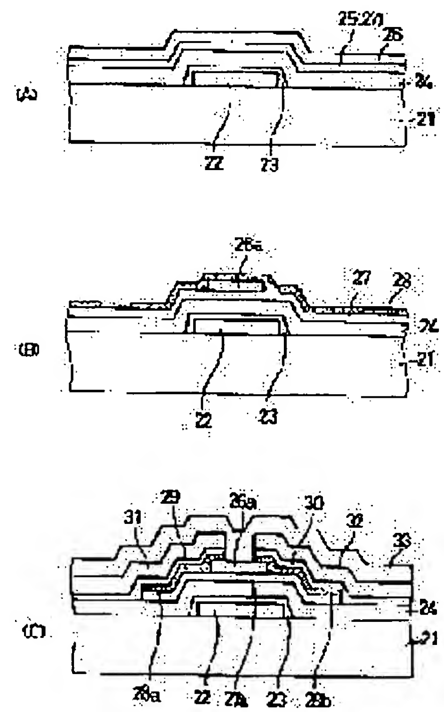
(54) MANUFACTURE OF SEMICONDUCTOR THIN FILM

(57)Abstract:

PROBLEM TO BE SOLVED: To enable dehydrogenation and crystallization of a hydrogen-containing amorphous silicon thin film in a short period of time.

SOLUTION: A hydrogen-containing amorphous silicon thin film 25 and a channel protective film forming film 26 made of silicon nitride are continuously deposited on the upper surface of a second gate insulating film 24. Thus, since the amorphous silicon thin film 25 is covered with the channel protective film forming film 26, subsequent dehydrogenation and crystallization processes may be carried out in the atmosphere. By irradiating the amorphous silicon thin film 25 with the light of an excimer lamp in the atmosphere, the amorphous silicon thin film 25 is dehydrogenated. Then, by similarly irradiating the amorphous silicon thin film 25 with an excimer laser in the atmosphere, the amorphous silicon thin film 25 is crystallized, thereby forming a polysilicon thin film 27.



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CLAIMS

[Claim]
[Claim 1] The manufacture technique of the semiconductor thin film characterized by crystallizing a part of aforementioned semiconductor thin film [at least] while the aforementioned semiconductor thin film is dehydrogenation-ized by forming an insulator layer on the semiconductor thin film of the shape of amorphous [of hydrogen inclusion], and irradiating excimer light into the ordinary-pressure ambient atmosphere at the aforementioned semiconductor thin film.
[Claim 2] It is the manufacture technique of the semiconductor thin film characterized by the aforementioned ordinary-pressure ambient atmosphere being the atmospheric air in invention of claim 1 publication.
[Claim 3] It is the manufacture technique of the semiconductor thin film characterized by for irradiation of an excimer lamp performing dehydrogenation-ization of the aforementioned semiconductor thin film, and performing crystallization of the aforementioned semiconductor thin film by irradiation of an excimer laser in invention the claim 1 or given in two.
[Claim 4] The manufacture technique of the semiconductor thin film characterized by irradiating the aforementioned excimer lamp and subsequently irradiating the aforementioned excimer laser in invention of claim 3 publication.
[Claim 5] It is the manufacture technique of the semiconductor thin film characterized by the semiconductor thin film of the shape of amorphous [aforementioned] being an amorphous silicon thin film in invention given in either of the claims 1-4.

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DETAILED DESCRIPTION

[Detailed description]
[0001]
[The technical field to which invention belongs] This invention relates to the manufacture technique of a semiconductor thin film.
[0002]
[Prior art] There is the technique of crystallizing the amorphous silicon thin film which ****ed and making it into a polysilicon contest thin film as an example, among the manufacture technique of a semiconductor thin film. And TFT may be formed by the crystallized polysilicon contest thin film. Drawing 3 shows an example of the manufacturing process of such conventional polysilicon contest TFT, and drawing 4 (A) - (D) shows the cross section in each status of the polysilicon contest TFT manufactured through the manufacturing process shown in drawing 3 , respectively. In case of a manufacture of this polysilicon contest TFT, in gate electrode formation process A first shown in drawing 3 , as shown in drawing 4 (A), the gate electrode 2 is formed in the predetermined part of the top of a glass substrate 1. Next, in two-layer continuity **** process B shown in drawing 3 , the gate insulator layer 3 and the genuineness hydrogen inclusion amorphous silicon thin film 4 are continued and ****ed on the whole top of the glass substrate 1 containing the gate electrode 2. Next, in dehydrogenation-ized process C shown in drawing 3 , when a high energy is given by excimer laser irradiation at a next process, in order to avoid that hydrogen bumps and a defect arises, the hydrogen concentration in the amorphous silicon thin film 4 is reduced by heat-treating with the vacuum electric furnace for dehydrogenation-izing.
[0003] Next, in crystallization process D shown in drawing 3 , by irradiating an excimer laser by the high-energy density into a vacuum, the genuineness amorphous silicon thin film 4 is crystallized, and the genuineness polysilicon contest thin film 5 is formed. Next, in impurity injection process E shown in drawing 3 , as shown in drawing 4 (B), the impurity injection mask 6 is formed on the field which serves as channel field 5a among the polysilicon contest thin films 5, and n type impurities, such as Lynn, are poured into all the fields except the field which serves as channel field 5a among the polysilicon contest thin films 5. Then, the impurity injection mask 6 is exfoliated. Next, in activation process F shown in drawing 3 , n type impurity injection field is activated by irradiating an excimer laser by the low-energy density. Next, in channel protective coat formation process G shown in drawing 3 , as shown in drawing 4 (C), the channel protective coat 7 is formed on the field which serves as channel field 5a among the polysilicon contest thin films 5.
[0004] Next, in device area formation process H shown in drawing 3 , as shown in drawing 4 (D), an unnecessary fraction is removed among the polysilicon contest thin films 5. In this status, the center section of the polysilicon contest thin film 5 is set to channel field 5a which consists of an intrinsic region, and the both sides are set to source field 5b and drain field 5c which consist of an n type impurity injection field. Next, in source drain electrode formation process I shown in drawing 3 , the source electrode 8 and the drain electrode 9 are formed in each top of the top both sides of the channel protective coat 7 and source field 5b, and drain field 5c etc. Next, in overcoat ****** process J shown in

drawing 3 , the overcoat layer 10 is ****ed on all the top. Next, in hydrogenation process K shown in drawing 3 , the dangling bond of the polysilicon contest thin film 5 is decreased by performing a hydrogen treating by the electric furnace for hydrogenation, or the plasma furnace for hydrogenation. In this way, bottom gate type polysilicon contest TFT is manufactured.

[Object of the Invention]

[0005] By the way, by the manufacture technique of such conventional polysilicon contest TFT, since the amorphous silicon thin film 4 is exposed as shown in drawing 4 (A) in case dehydrogenation-ized process C and crystallization process D which are shown in drawing 3 are performed, it is carrying out in the vacuum. For this reason, the vacuum length in dehydrogenation-ized process C and crystallization process D took time, and there was a problem that a throughput was not good. The technical probrem of this invention is enabling it to perform a dehydrogenation-ized process and a crystallization process for a short time.

[0006]

[The means for solving a technical problem] This invention forms an insulator layer on the semiconductor thin film of the shape of amorphous [of hydrogen inclusion], and by irradiating excimer light into the ordinary-pressure ambient atmosphere at the aforementioned semiconductor thin film, it crystallizes a part of aforementioned semiconductor thin film [at least] while it dehydrogenation-izes the aforementioned semiconductor thin film.

[0007] According to this invention, since the insulator layer is formed on the semiconductor thin film of the shape of amorphous [of hydrogen inclusion], a semiconductor thin film cannot be exposed, therefore dehydrogenation-izing and crystallization of a semiconductor thin film can be performed into the ordinary-pressure ambient atmosphere. Consequently, vacuum length like before becomes unnecessary and a dehydrogenation-ized process and a crystallization process can be performed for a short time.

[0008]

[Gestalt of implementation of invention] Drawing 1 shows the manufacturing process of the polysilicon contest TFT which applied the 1 enforcement gestalt of this invention, and drawing 2 (A) - (C) shows the cross section in each status of the polysilicon contest TFT manufactured through the manufacturing process shown in drawing 1 , respectively. In case of a manufacture of this polysilicon contest TFT, as gate electrode formation process A first shown in drawing 1 is shown in drawing 2 (A), the gate electrode 22 which consists of an aluminum-titanium alloy is formed in the predetermined part of the top of a glass substrate 21. Next, in anodic oxidation process B shown in drawing 1 , the 1st gate insulator layer 23 which consists of an aluminum oxide is formed in the front face of the gate electrode 22 by performing an anodizing. Next, in three layer continuity **** process C shown in drawing 1 , the layer (insulator layer) for channel protective coat formation 26 which consists of the 2nd gate insulator layer 24, the genuineness hydrogen inclusion amorphous silicon thin film (semiconductor thin film) 25, and silicon nitride which consist of a silicon nitride is continuously ****ed by PE-CVD on the whole top of the glass substrate 21 containing the 1st gate insulator layer 23.

[0009] Next, although dehydrogenation-izing and crystallization process D shown in drawing 1 are explained, since the layer for channel protective coat formation 26 is ****ed on the genuineness hydrogen inclusion amorphous silicon thin film 25 in this case, it is enabled for the genuineness hydrogen inclusion amorphous silicon thin film 25 not to be exposed, therefore to carry out into the ordinary-pressure ambient atmosphere, for example, the atmospheric air. Then, dehydrogenation-ized processing of the genuineness hydrogen inclusion amorphous silicon thin film 25 is performed by irradiating the synchrotron orbital radiation (excimer light) of an excimer lamp into the atmospheric air first. In this case, although a glass substrate 21 is passed, the excimer lamp irradiation area consists the excimer lamp irradiation area of a preheating area and this heating area. While it prevents that reach gate electrode 22 in this heating area, and a hillock occurs to the aluminum in the 1st gate insulator layer 23 by the continuous irradiation with a heating temperature of 250 degrees C or less, the heat stress of a glass substrate 21 is made to ease in a preheating area. In this heating area, the continuous irradiation in the elevated temperature below the melting point of the aluminum-titanium alloy which is the material

of the gate electrode 22 performs dehydrogenation-ized processing of the genuineness hydrogen inclusion amorphous silicon thin film 25 for a short time.
[0010] Next, if it is 2 or less-about 150mJ/cm and an excimer laser (excimer light) is similarly irradiated by the low-energy density into the atmospheric air, the genuineness amorphous silicon thin film 25 will crystallize, and the genuineness polysilicon contest thin film 27 will be formed. In this case, since hydrogen contains in the silicon nitride film which forms the layer for channel protective coat formation 26, it is for avoiding that this hydrogen bumps especially to make the energy density of an excimer laser low with 2 or less-about 150mJ/cm. Moreover, even if the energy density of an excimer laser is as low as 2 or less-about 150mJ/cm, micro crystal (what is not being crystallized is included) about 1 micrometer or less is formed. Thus, since a dehydrogenation-ized process and a crystallization process can be continuously performed in the atmospheric air, vacuum length like before can become unnecessary, can perform a dehydrogenation-ized process and a crystallization process for a short time, and can improve a throughput. In addition, you may be made to perform irradiation of the excimer laser in a crystallization process by carrying out scanning irradiation, making the long and slender laser beam which has short width of face for a beam size and which was made beltlike overlap crosswise [of a beam size]. In this case, the amount of overlap is more preferably made into 90 - 99% 50% or more.
[0011] Next, in channel protective coat formation process E shown in drawing 1 , as shown in drawing 2 (B), channel protective coat 26a is formed in the predetermined part on the polysilicon contest thin film 27 by removing an unnecessary fraction among the layers for channel protective coat formation 26. Next, in n type silicon **** process F shown in drawing 1 , n type silicon layer 28 by which Lynn etc. was doped by the whole top of the polysilicon contest thin film 27 containing channel protective coat 26a by PE-CVD is ****ed. Next, in device area formation process G shown in drawing 1 , as shown in drawing 2 (C), while an unnecessary fraction is removed among n type silicon layers 28 and source field 28a and drain field 28b are formed, an unnecessary fraction is removed among the polysilicon contest thin films 27, and channel field 27a is formed. That is, source field 28a and drain field 28b are formed in the top both sides of channel protective coat 26a, and each top of channel field 27a in the both sides. In this case, channel field 27a consists of contest intrinsic polysilicon, and source field 28a and drain field 28b consist of n type silicon. Thus, since source field 28a and drain field 28b are formed with n type silicon layer which ****ed, an impurity injection process and an activation process become unnecessary, therefore a manufacturing process can be simplified also by this. In addition, source field 28a and drain field 28b may consist of an n type amorphous silicon or contest n type polysilicon.
[0012] the [next, / the 1st source electrode 29 which becomes each top of source field 28a and drain field 28b etc. from chromium in source drain electrode formation process H shown in drawing 1 , and] -- the [the 2nd source electrode 31 which forms 1 drain electrode 30, and becomes each of that top from an aluminum-titanium alloy continuously, and] -- 2 drain electrode 32 is formed Next, in overcoat ****** process I shown in drawing 1 , the overcoat layer 33 is ****ed on all the top. Next, in hydrogenation process J shown in drawing 1 , the dangling bond of channel field 27a, source field 28a, and drain field 28b is decreased by performing a hydrogen treating by the electric furnace for hydrogenation, or the plasma furnace for hydrogenation. In this way, bottom gate type polysilicon contest TFT is manufactured.
[0013] by the way, when [with the former of the same type] it is got blocked and it compares with the manufacturing process of bottom gate type amorphous silicon TFT, the manufacturing process shown in drawing 1 [only being added to dehydrogenation-izing and crystallization process D, and] If the excimer lamp equipment and excimer laser equipment for dehydrogenation-izing and crystallization process D are added to the manufacture process line of conventional bottom gate type amorphous silicon TFT The polysilicon contest TFT of this invention can be manufactured by changing the manufacture process line of conventional bottom gate type amorphous silicon TFT a little, and using it as it is. In addition, this invention is applicable also to p type polysilicon contest TFT.
[0014]
[Effect of the invention] Since dehydrogenation-izing and crystallization of the shape of amorphous of a semiconductor thin film can be performed into the ordinary-pressure ambient atmosphere according to

this invention as explained above, vacuum length like before can become unnecessary, can perform a dehydrogenation-ized process and a crystallization process for a short time, and can improve a throughput.

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TECHNICAL FIELD

[The technical field to which invention belongs] This invention relates to the manufacture technique of a semiconductor thin film.

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PRIOR ART

[Prior art] There is the technique of crystallizing the amorphous silicon thin film which ****ed and making it into a polysilicon contest thin film as an example, among the manufacture technique of a semiconductor thin film. And TFT may be formed by the crystallized polysilicon contest thin film. Drawing 3 shows an example of the manufacturing process of such conventional polysilicon contest TFT, and drawing 4 (A) - (D) shows the cross section in each status of the polysilicon contest TFT manufactured through the manufacturing process shown in drawing 3 , respectively. In case of a manufacture of this polysilicon contest TFT, in gate electrode formation process A first shown in drawing 3 , as shown in drawing 4 (A), the gate electrode 2 is formed in the predetermined part of the top of a glass substrate 1. Next, in two-layer continuity **** process B shown in drawing 3 , the gate insulator layer 3 and the genuineness hydrogen inclusion amorphous silicon thin film 4 are continued and ****ed on the whole top of the glass substrate 1 containing the gate electrode 2. Next, in dehydrogenation-ized process C shown in drawing 3 , when a high energy is given by excimer laser irradiation at a next process, in order to avoid that hydrogen bumps and a defect arises, the hydrogen concentration in the amorphous silicon thin film 4 is reduced by heat-treating with the vacuum electric furnace for dehydrogenation-izing.
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EFFECT OF THE INVENTION

[Effect of the invention] Since dehydrogenation-izing and crystallization of the shape of amorphous of a semiconductor thin film can be performed into the ordinary-pressure ambient atmosphere according to this invention as explained above, vacuum length like before can become unnecessary, can perform a dehydrogenation-ized process and a crystallization process for a short time, and can improve a throughput.

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